ATXI Exhibit 1.0 (RH) (Rev.)

ILLINOIS COMMERCE COMMISSION

DOCKET No. 12-0598

REVISED DIRECT TESTIMONY ON REHEARING

OF

DENNIS D. KRAMER

Submitted On Behalf

Of

AMEREN TRANSMISSION COMPANY OF ILLINOIS

December 16, 2013

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Submitted On Behalf Of

Ameren Transmission Company of Illinois

I. INTRODUCTION

Q. Please state your name, business address and present position.

A. My name is Dennis D. Kramer, and my business address is One Ameren Plaza 1901 Chouteau Avenue, St. Louis, Missouri 63103. I am currently the Senior Director of Transmission Policy and Planning at Ameren Services Company (Ameren Services).

Q. Are you the same Dennis D. Kramer who sponsored direct and rebuttal testimony in the initial phase of this proceeding?

A. Yes, I am.

II. PURPOSE AND SCOPE

Q. What is the purpose of your direct testimony on rehearing?

A. My testimony addresses three topics.

- I explain, from an electric planning and reliability standpoint, the concerns with adopting the Pawnee to Kincaid to Mt. Zion route identified in Staff's October 16, 2013 filing. These concerns include loss of the benefits to the Ameren Illinois Company d/b/a Ameren Illinois (Ameren Illinois) area customers of additional 345 kV connections to Pana, creation of a new reliability issue and reduction of system benefits, and a potential inability to meet the needed 2016 in service date to address certain North American Electric Reliability Corporation

(NERC) Category C overloads and voltage issues in Decatur. I also explain that the Kincaid connection is estimated to actually result in higher costs being paid by the Ameren Illinois area customers when compared to the Pana connection (approximately $43 million for the Kincaid connection compared to approximately $18 million for the Pana connection). Therefore I recommend that the Illinois Commerce Commission (Commission) approve Ameren Transmission Company of Illinois' (ATXI) Pawnee to Pana and Pana to Mt. Zion routes, including the location of the Pana and Mt. Zion area substations as proposed by ATXI.

- Second, I recommend the Mt. Zion substation should be located where ATXI has recommended, because that location is closer to the load it will serve.

- Third, I explain the electric planning rationale for the Illinois Rivers Project's (Project) substation bus configurations, including the need for physically planning and arranging the Ipava and Rising substations for eventual Breaker And-a-Half (BAAH) bus configurations.

Q. Are you sponsoring any exhibits in support of your testimony?

A. Yes, I sponsor the following:

- ATXI Exhibit 1.1 (RH): Electrical diagram of a ring bus configuration
- ATXI Exhibit 1.2 (RH): Electrical diagram of a double ring bus configuration
- ATXI Exhibit 1.3 (RH): Electrical diagram of a BAAH bus configuration
- ATXI Exhibit 1.4 (RH): Example of potential split ring bus condition at Kincaid
- ATXI Exhibit 1.5 (RH): Existing Kincaid ring bus one line diagram
- ATXI Exhibit 1.6 (RH): Comparison of Pana connection cost to Kincaid connection cost
- ATXI Exhibit 1.7 (RH): Electrical diagram of straight bus configuration
- ATXI Exhibit 1.8 (RH): Electrical diagram of double bus, double breaker bus configuration
- ATXI Exhibit 1.9 (RH): ATXI Exhibits 2.11, 2.13 and 2.14 (combined)

III. EVALUATION OF THE KINCAID CONNECTION

Q. What is the Kincaid connection?

A. The Kincaid connection is a suggested route that connects the eastern portion of the Project to Mt. Zion through Kincaid instead of Pana. The Commission excluded the Pawnee to Pana and Pana to Mt. Zion routes from the Order and Certificate because it was not persuaded that those routes were the least-cost routes relative to what was referred to as a possible Kincaid route. In granting rehearing on this issue, the Commission directed Staff to prepare and submit a potential Kincaid route. Staff did so, filing its route information on October 16, 2013. Staff's Kincaid connection would rely on an existing 345 kV line owned by Ameren Illinois that connects Pawnee to Commonwealth Edison Company's (ComEd) Kincaid substation, and a new 345 kV line that would be built by ATXI to connect the Kincaid substation to a new Mt. Zion area substation. My testimony refers to Staff's Pawnee to Kincaid to Mt. Zion route and a new Mt. Zion area substation as the "Kincaid connection." ATXI's proposed Pawnee to Pana to Mt. Zion route, a new Mt. Zion area substation, the rebuilding of the Pana substation at a new site, and relocation of the substation equipment are referred to as the "Pana connection." A new Mt. Zion area substation has been approved by the Commission, therefore each connection alternative includes the new Mt. Zion area substation in its description because it will be constructed regardless of which connection is approved.

Q. Did Staff recommend that the Commission choose the Kincaid connection over the Pana connection?

A. It did not. Staff's October 16, filing makes clear that it developed its Kincaid connection with the goal of meeting the Commission's directive "as soon as possible." And Staff's filing comes with a major caveat: "Staff notes that it has had insufficient time to consult with utilities, affected landowners, other state, federal or local agencies of government, or any other entity which might have knowledge regarding the costs, feasibility, or other impact of Staff's proposed route, or a stake in the outcome."

Q. Why did ATXI propose the Pana connection?

A. During the development of the multi-value project (MVP) Portfolio, Ameren Services and ATXI worked to maximize the benefit and value the portfolio would provide to Ameren Illinois area customers. As part of the effort, ATXI proposed the Pana connection as a potential transmission line and substation combination that would provide system benefits. The Pana connection provides increased stability and capability for the Coffeen and Kincaid power plants to withstand transmission system disturbances and remain connected to the grid. It will address certain identified future reliability issues in the Decatur area (NERC Category C overloads and voltage issues) that need to be addressed by 2016, as explained in my direct testimony and shown in ATXI 1.9 (RH) (ATXI Exs. 2.11, 2.13 and 2.14). Importantly, the Pana connection would include the rebuilding of the Pana substation at a new site and relocation of substation equipment and transmission lines. These steps are required due to mine subsidence at the existing Pana 345 kV substation, and the cost would be shared as part of an MVP. The Pana connection also provides additional 345 kV sources to the Pana substation, which is a major 138 kV hub with five networked 138 kV transmission lines, and which currently has only has a single 345 kV source.

Q. How does the cost of ATXI's Pawnee to Pana to Mt. Zion connection compare to a connection through Kincaid?

A. A Pana connection will impose lower costs on Ameren Illinois area customers than a Kincaid connection. As shown in the cost analysis in ATXI Exhibit 1.6 (RH), although the transmission line route length for a Kincaid connection is shorter, one must also factor in the need to add and upgrade facilities at Kincaid substation to accommodate the connection, the need for rebuilding the Pana substation on a new site no matter what the Commission determines on Kincaid, and the effect of MVP cost sharing, under which the cost of MVP projects are shared by customers across the entire Midcontinent Independent System Operator (MISO) footprint (as opposed to local reliability projects, the cost of which are borne by the local customers they benefit). The cost of the Pana connection (transmission line and substations, with MVP cost sharing) to Ameren Illinois area customers is approximately $18 million. By comparison, the Kincaid connection (including required upgrades and relocation of the Pana substation, and with only the transmission line and Mt. Zion substation cost shared) would cost Ameren Illinois area customers at least $44 million. In other words, the "all-in" cost to Ameren Illinois area customers would be significantly higher with a Kincaid connection. ATXI expects a more complete analysis of the Kincaid connection would probably identify additional system upgrades that need to be addressed, which will increase the cost of the Kincaid connection. However, even absent these as-yet unknown costs, as indicated above, the Kincaid connection is more expensive for Ameren Illinois area customers than the Pana connection.

Q. Would connecting in Kincaid rather than Pana provide the same benefits?

A. No. The benefits of the Pana connection are benefits that the Kincaid connection either fails to provide, or provides too late to meet the transmission system requirements. The Kincaid connection does not provide the same level of increased stability for the Coffeen power plant. The Kincaid connection would not address Decatur reliability issues before 2018, and therefore other actions will be needed to address the Decatur area's exposure to low voltages and outages between 2016 and 2018. Lastly, the cost of the rebuilding the Pana substation at a new site and relocation of substation equipment and transmission lines would be borne entirely by Ameren Illinois area customers.

Q. Why, if the Commission directs that the Kincaid connection should be implemented, with its new transmission line routed through Kincaid and connecting to a new Mt. Zion area substation, will other actions be needed to address the exposure to low voltage and possible loss of load in the Decatur area from 2016 until 2018?

A. Ameren Services cannot simply ignore the need to address the Decatur area reliability issues that need to be addressed in 2016. As I discuss below, Ameren Services' analysis of the Illinois transmission grid indicated that the Pana to Mt. Zion line and the new Mt. Zion area substation was the preferred project to address the future Decatur area reliability issues in 2016. I documented this fact in my rebuttal testimony - ATXI Exhibit 11.4 "Possible alternative reliability projects if ATXI did not construct the Project." The exhibit lists the Pana to Mt. Zion 345 kV line and Mt. Zion 345/138 kV transformer as being needed in 2016 if the Project is not constructed. If the Kincaid connection is not in service until an estimated 2018, other actions will need to be implemented to address the reliability needs in Decatur in the 2016 to 2018 time period.

Q. Would the Kincaid connection create system issues not present with a Pana connection?

A. Yes. Based upon our analysis to date, the Kincaid connection will create system conditions that could overload the planned 345/138 kV transformer that will be located at the new Mt. Zion area substation. A complete system impact study would be needed to identify the full set of needed system improvements in both MISO and PJM Interconnection, LLC (PJM) to safely and reliably implement the Kincaid connection. A Kincaid connection would also increase the potential for congestion in the central section of Illinois. Lastly, as discussed above, a Kincaid connection would not address the reliability issues in Decatur any earlier than 2018, leaving Decatur exposed to the risk of low voltage and potential loss of load from 2016 until 2018 unless other actions are implemented to address the two-year window of exposure.

Q. How would a Pana connection improve stability at the Coffeen and Kincaid power plants?

A. Both the Kincaid and Coffeen power plants are synchronous generators, which means they are connected to the electric grid in such a way that the rotors of both generators are in synchronized rotation. The transmission system and generators are designed to maintain this steady-state synchronized condition. The steady-state condition can be upset by sudden changes in load, system faults that lead to de-energization of transmission lines, or other events that occur on the electric grid. Improving the stability of a power plant is important because it increases the plant's ability to withstand major disturbances created by short circuits, de-energization of transmission lines, and similar system events, and remain connected to the electric grid. Sudden disconnecting of power plants from the electric grid can intensify and expand the major disturbance that was the initial cause of the power plant disconnecting from the electric grid. Therefore, an increase in the ability for a power plant to withstand a system disturbance and remain connected to the grid is a desirable benefit from any transmission system improvement.

Q. Did MISO perform a stability analysis related to the Pana connection?

A. Yes. MISO performed analysis documented in Mr. Jeff Webb's testimony, MISO Exhibit 1.0 dated November 8, lines 427-41, which states the following:

> Our analysis also identified generator instability at the Coffeen generating station. This condition arises when a fault occurs on the 345 kV substation equipment at Coffeen under the projected future system conditions. Unstable generators are a safety hazard as the generator rotor and turbine accelerate to unsafe levels, and therefore need to be removed from the system which can exacerbate the system voltage and supply capability. The Project provides additional 345 kV capability to deliver the Coffeen station generation by providing new outlets from Pana, which is directly connected to Coffeen. Specifically, the Project provides a new outlet from Pana to Sugar Creek, forming a path parallel to the heavily loaded existing Coffeen outlet to Ramsey 345 KV. This additional capability mitigates the instability condition.

Q. Did ATXI also perform a stability analysis related to the Pana connection?

A. Yes. ATXI analyzed the electric grid in central Illinois with the Kincaid connection in service compared to the Pana connection in service. We determined that the Pana connection improved the stability of the Kincaid power plant by approximately 5%. The Pana connection also improved the stability of the Coffeen power plant by approximately 10%, compared to the Kincaid connection's 0% improvement of Coffeen stability. This additional stability improves the capability of these generators to withstand system disturbances and thereby increases the overall grid reliability in the central section of Illinois.

Q. What is the benefit of the Pana connection with respect to the need for relocating the Pana 345 kV substation to a new site?

A. As explained in Mr. Hackman's testimony, the existing Pana substation site is experiencing mine subsidence and must be relocated to a more stable location in the near future. The additional 345 kV connections at Pana that are part of the Project cannot be connected to the existing Pana substation due to the mine subsidence problem. Therefore, as part of the Project, the rebuilding of the Pana substation at a new location and relocation of equipment and existing lines is included as part of the MVP portfolio and will be cost shared across the MISO footprint. If the Kincaid connection is approved, the Project will no longer connect to the Pana substation, and therefore the needed rebuilding of the Pana transmission substation at a new site and associated relocation work will no longer be part of the MVP portfolio and will not be cost shared. Ameren Illinois area customers would then bear the entire cost of the necessary rebuilding of the Pana substation at a new site and relocation of the existing substation equipment and transmission lines.

Q. Why is there is a risk of overloads on the Mt. Zion area substation transformer and increased transmission system congestion in central Illinois with the Kincaid connection compared to the Pana connection?

A. Because of the substation bus configuration at Kincaid.

Q. What is a substation bus?

A. A substation bus (or "bus bar" as it is sometimes called) is a metal bar within the substation that conducts electricity. The bus provides a physical point for transmission lines, transformers, generator output lines, and capacitor banks to be electrically interconnected within a substation. There are several types of electrical bus designs used in transmission substations, and each design has benefits and limitations, which are dependent upon the number of connections to the bus.

Q. Are there different types of substation bus configurations?

A. Yes. Of relevance to the discussion of the Kincaid connection are ring bus, double ring bus, and BAAH configurations.

In a ring bus configuration, there is a closed loop of buses with each bus section separated by a circuit breaker. See ATXI Exhibit 1.1 (RH) for an electrical diagram of a ring bus configuration. This allows a circuit breaker to be de-energized for maintenance activities while still keeping the associated transmission line electrically connected to the bus. A limitation of the ring bus design with five or more connections is that if, due to maintenance activities or system faults, circuit breakers will be open and there is the potential for the ring bus to be divided into undesirable combinations of transmission lines, generators and other equipment that is connected to the ring bus. This situation can cause system congestion and higher energy prices. Therefore in order to greatly reduce the potential for system congestion, ring bus configurations work best when no more than four separate connections are made to the bus.

A double ring bus configuration is two ring buses with usually two electrical connections between the rings. See ATXI Exhibit 1.2 (RH) for an electrical diagram of a double ring bus configuration. This configuration is an improvement over a very large single ring bus with many connections because it limits the impact of a bus fault to only one of the rings. However, a double ring bus can still be split into separate bus sections due to a combination of maintenance activities or system faults, which may cause congestion.

In a BAAH configuration, for every two transmission lines there are three circuit breakers with each transmission line sharing a common center circuit breaker. The combination of two transmission lines and their associated three circuit breakers are commonly referred to as a "breaker-string." At the end of each breaker-string is an electrical bus, which provides a connection between the breaker strings. See ATXI Exhibit 1.3 (RH) for an electrical diagram of a BAAH bus configuration. Any circuit breaker can be removed for maintenance without effecting the connection of any transmission line to an electrical bus. A fault on one bus will not impact the other bus and therefore all connections to the transmission lines will be maintained. This configuration provides improved reliability and enhanced operational flexibility compared to a ring bus configuration or a double ring bus configuration.

Q. So why does the Kincaid connection create the risk of overloads on the Mt. Zion area substation transformer?

A. Because of the Kincaid ring bus arrangement. For example, if a Kincaid ring bus circuit breaker was out of service for maintenance, and a transmission line fault occurred, then another pair of Kincaid ring bus circuit breakers would open to disconnect the transmission line with the fault from the bus. This would result in the Kincaid ring bus being split into two separate buses. ATXI Exhibit 1.4 (RH) is a single-line diagram of the Kincaid ring bus arrangement (with a hypothetical new Kincaid to Mt. Zion line connection) which shows the bus in the normal operation closed loop condition and one of several potential split bus conditions. Splitting of the Kincaid ring bus into two separate buses could also occur if a transmission line fault followed by a second transmission line fault occurred. Under these scenarios, the MISO MVP planned and approved Mt. Zion area substation 560 MVA transformer could be overloaded to approximately 700 MVA. To mitigate this overload could require additional facilities be installed in the Decatur area, resulting in additional Kincaid connection project costs. Another potential method to mitigate the overloading would be to reconfigure the Kincaid 345 kV bus into a BAAH configuration or a double ring bus configuration and change the transmission line connection locations.

Q. Aside from the operational and reliability issues, what effect would this overloading have on the cost of the Kincaid connection?

A. Mitigation of the potential overloads described above could require a second Mt. Zion transformer and potentially additional Decatur area 138 kV reinforcements beyond those that may be needed if the Pana connection was implemented. The second transformer and incremental 138 kV reinforcements would result in additional project costs for the Kincaid connection. As I stated previously, another option, which provides greater benefits, would be to convert the Kincaid 345 kV single ring bus to a BAAH configuration or a double ring bus configuration. Both of these bus reconfigurations would increase the cost of the Kincaid connection but would help address the concerns with transmission system congestion that I discuss later in my testimony.

Q. Does the risk of overload exist if the Pana connection is implemented?

A. No. The size of the Mt. Zion transformer is 560 MVA, which was determined assuming the entire MVP portfolio (including the Pana connection) would be constructed. Therefore, if the Pana connection is implemented as proposed by ATXI, the Mt. Zion substation transformer would not be overloaded under the scenarios described above.

Q. Why is it otherwise beneficial to have additional 345 kV supplies into Pana?

A. The Pana substation currently has a single 345 kV supply (a simple direct tap off of the existing Coffeen-Kincaid 345 kV line). The Pana connection would provide additional 345 kV supplies from Pawnee and from Mt. Zion substations. This is beneficial because the current 345 kV supply to the Pana substation is exposed to the entire length of the Coffeen-Kincaid line, which is approximately 58 miles. A fault along any portion of the Coffeen-Kincaid line will result in the Pana substation losing its 345 kV support. Therefore it is advantageous to have additional 345 kV supplies to Pana substation.

Q. You previously mentioned system congestion. What is system congestion?

A. Transmission system congestion occurs when there is an economic benefit from increasing the energy flow on a transmission line or piece of equipment but the increased flow cannot be accommodated. Mitigating congestion usually requires reducing low cost generation and increasing the use of higher cost generation to supply customer load. Thus, congestion results in a higher cost of energy for customers.

Q. Is congestion already a concern with the existing Kincaid 345 kV ring bus and its multiple connections?

A. Yes. The Kincaid substation currently has a seven position 345 kV ring bus configuration as shown in ATXI Exhibit 1.5 (RH). As previously described, ring bus configurations work best when no more than four separate connections are made to the bus. In the scenarios I described above (a circuit breaker out of service for maintenance followed by a transmission line fault that causes another pair of Kincaid circuit breakers to open, or a transmission line fault followed by a second transmission line fault), the Kincaid ring bus could electrically split into two or more separate buses. Splitting the ring can result in undesirable combinations of transmission lines being grouped on the separated bus sections. This in turn can result in system congestion. With the Kincaid ring bus configuration, Ameren Illinois customers have in the past experienced higher energy prices due to congestion impacts caused by the Kincaid 345 kV bus being electrically split.

Q. Does the Kincaid connection make the transmission system in central Illinois even more susceptible to congestion?

A. Yes. The Kincaid connection would add another 345 kV line position to the already crowded Kincaid substation 345 kV ring bus and increase the size of the Kincaid ring bus to 8 connection points. Each additional position added to the ring bus further increases the potential for splitting the bus into two or more electrically separate buses. This increases the likelihood of undesirable combinations of transmission lines and other equipment that is connected to the ring bus and increases the possibility for additional congestion in the central Illinois area. Additionally, during the lengthy construction project to implement the Kincaid connection, portions of the Kincaid 345 kV bus will be out of service in order to add the new line position for the Kincaid to Mt. Zion line. During the construction period, the Ameren Illinois area load will have an increased probability of experiencing higher energy prices due to congestion caused by the splitting of the Kincaid bus.

Q. Is it feasible to address the concerns associated with the Kincaid ring bus configuration?

A. Possibly, however Kincaid is owned by ComEd so any connections to the bus or revisions to its arrangement would need to be approved by ComEd and the PJM Regional Transmission Operator (RTO). Based upon our knowledge of the physical space and layout of the Kincaid substation site, ATXI does not believe it is feasible to convert the simple ring bus into a more robust and flexible BAAH arrangement. Another less costly but also less effective option would be to reconfigure the Kincaid ring bus into a double ring bus arrangement. This would be an improvement compared to a single ring bus configuration; however system congestion could still occur due to splitting the bus into separate sections.

Q. You indicated that adoption of the Kincaid connection could cause a delay in addressing reliability issues in Decatur. Why?

A. Because of the additional time needed to study the Kincaid connection and coordinate with ComEd and PJM.

Q. What would ATXI need to do to study a Kincaid connection?

A. The Kincaid connection would require extensive analysis to identify the specific equipment upgrades and system improvements necessary for it to be safely and reliably implemented. The following is a list of the major activities that would need to occur to identify the system improvements needed to safely and reliably implement the Kincaid connection:

- ATXI would have to establish an agreement between ComEd, PJM, ATXI, AIC and MISO for ComEd and PJM to perform a system impact study to determine the system improvements needed on the ComEd and PJM transmission systems to implement the Kincaid connection and address any possible reliability issues the Kincaid connection may create on the ComEd and PJM transmission systems;

- ATXI would have to gather needed system model data from ATXI, AIC, and MISO and submit the information to ComEd and PJM;

- Ameren Services and MISO would have to coordinate and support ComEd's and PJM's performance of the system impact study;

- Ameren Services would have to perform a system impact study to determine the impact of the Kincaid connection on the ATXI, Ameren Illinois and Ameren Missouri transmission systems and system improvements needed on those transmission systems to address reliability issues created by the Kincaid connection; and

- MISO would have to perform an impact study to determine the impact of the Kincaid connection on the non-Ameren portion of the MISO transmission system and system improvements needed on the non-Ameren portion of the MISO transmission system to address possible reliability issues created by the Kincaid connection.

Only after the completion of the above listed activities, would the actual transmission system upgrades needed to safely and reliably implement the Kincaid connection be known and documented.

Q. Wouldn't the studies you just mentioned be needed for a Pana connection?

A. Yes, and these studies have already been completed for the Pana connection. They have not even been started for a Kincaid connection.

Q. How long would it take to complete these studies for the Kincaid connection?

A. It will require 12 to 15 months to complete studies to determine all the system upgrades on the ComEd, PJM, ATXI, AIC and MISO transmission systems that are required to safely and reliably implement the Kincaid connection. This means a cost estimate based upon the actual system upgrades necessary to safely and reliably implement the Kincaid connection will not be known until at the earliest March of 2015. Implementing the Kincaid connection would involve a new connection at the very electrically and physically crowded Kincaid substation. Therefore the system impact study agreement would be more complex and detailed compared to other simpler and more common interconnections. In addition, the analyses to identify the system upgrades required to implement the Kincaid connection and identify potential impacts and needed system improvements on the rest of the ComEd system will require significantly more time than usual. Lastly, the PJM RTO would need to know the planned Kincaid 345 kV bus upgrades before it could complete its analysis of their potential impact on the non-ComEd portion of the PJM RTO.

Q. When would you estimate the Kincaid connection going into service?

A. Based upon Mr. Hackman's testimony, if the Kincaid connection was approved in March 2014 in this proceeding, and coordination and approvals from ComEd and PJM took 12-15 months, a typical construction schedule would produce an in-service date of no earlier than 2018.

Q. What would be the consequence of a 2018 in-service date?

A. The Decatur area would be exposed to low voltages and potential outages after 2016, as necessary reliability improvements in Decatur are delayed.

Q. What reliability improvements are you referring to?

A. I identified certain NERC Category C overloads and voltage issues in Decatur in my direct testimony as shown in ATXI Exhibit 1.9 (RH). The portion of the Pana connection that includes the Pana-Mt. Zion 345 kV line and new Mt. Zion area substation provide a 345 kV source to address these reliability issues. There is no meaningful dispute that there are reliability issues in Decatur that need to be addressed, or that the Pana-Mt. Zion 345 kV line and Mt. Zion area substation would address them. The Commission's Order found a Mt. Zion substation necessary. Staff agrees that ATXI and MISO demonstrated that a new 345/138 kV substation to supply the Decatur area from ATXI's proposed new 345 kV transmission line is a necessary part of the Project. (ICC Staff Response to Data Request Channon-ICC 1.02.) A connection is also needed to accommodate additional load planned at the ADM facility near Decatur. The current information is that the amount of load increase will be 70 MVA by 2017.

Q. Would the Kincaid connection provide a 345 kV source to address these concerns?

A. Possibly. A full analysis would need to be performed to verify its capability to address the full set of reliability issues in the Decatur area and determine if it creates additional system reliability concerns. Its estimated in-service date of 2018 would be two years after 2016 when the reliability issues need to be addressed.

Q. Why is a connection needed by 2016?

A. The Decatur area will be exposed to low voltages and potential loss of load beginning in 2017 for certain NERC contingency events as described in my direct testimony (see ATXI Exhibit 1.9 (RH)). This analysis did not include the previously mentioned additional 70 MVA of additional load at the ADM facility near Decatur, therefore the need for an additional 345 kV supply to the Decatur area is more acute than was indicated in the analysis and associated exhibits. But if the Kincaid connection is selected, it is expected that it would not be able to provide the needed additional 345 kV supply to the Decatur area until at the earliest 2018. This means that other actions will need to be implemented to address the Decatur area risk of low voltage and loss of load between 2016 when the reliability issues need to be addressed and the 2018 in service date of the Kincaid connection.

Q. You indicated a Kincaid connection would not cost less. Why?

A. Any possible project cost savings to the Ameren Illinois area customers from the substitution of the Kincaid connection for the Pana connection are more than offset and in fact completely eliminated by the estimated cost of upgrades needed to implement the Kincaid substation and the cost of rebuilding the Pana transmission substation at a new site due to mine subsidence which is not cost shared across the MISO footprint.

It should be noted that I have not estimated and included the cost of possible system upgrades needed on the PJM and MISO transmission systems due to the Kincaid connection. I also have not estimated and included the cost of actions to address the Decatur area reliability issues between 2016 and whenever the Kincaid connection is implemented. As previously described, additional detailed studies will be required to determine the required system upgrades and actions and their associated costs.

Q. What costs would be incurred if a Kincaid route were selected?

A. The cost items include:

- Additional equipment needed to add another connection to the Kincaid bus. Conversion of the Kincaid ring bus to a double ring bus configuration, with two additional circuit breakers being used to connect the two separate rings, to address the shortcomings of the Kincaid ring bus configuration and to prevent the overloaded condition on the Mt. Zion area substation transformer.

- A 41 mile 345 kV line from Kincaid substation to the Staff's proposed location for the new Mt. Zion area substation.
- Equipment and construction of the new Mt. Zion area 345/138 kV substation
- Rebuilding of Pana 345/138 kV substation at a new site and relocation of the existing Pana substation equipment and transmission lines to the rebuilt substation (no longer be part of the MVP Portfolio and be cost shared across the MISO footprint.)

Q. Have you quantified the cost effect?

A. Yes. A summary of the cost analysis is shown on ATXI Exhibit 1.6 (RH). This reflects a cost to the Ameren Illinois area customers if the Pana connection is implemented (transmission line and substations, with MVP cost sharing) of approximately $18 million. By comparison, the cost to the Ameren Illinois area customers if the Kincaid connection (with only the transmission line and Mt. Zion substation cost shared) would be approximately $43 million (exclusive of the cost of possible system upgrades needed on the PJM and MISO transmission systems due to the Kincaid connection and the cost of actions to address the Decatur area reliability issues between 2016 and whenever the Kincaid connection is implemented). As the previous discussion and analysis clearly shows, the Ameren Illinois area customers will pay more for the Kincaid connection with the potential for even greater costs and still receive fewer reliability benefits than the Pana connection. The Commission should therefore approve the Pana connection, which includes the Pawnee to Pana to Mt. Zion 345 kV line, the new Mt. Zion area substation and the rebuilding of the Pana substation on a new site and the relocation of the substation equipment and lines.

IV. EVALUATION OF THE KINCAID CONNECTION PROPOSED LOCATIONS FOR THE NEW MT. ZION SUBSTATION

Q. Does Staff's identified route for the Kincaid connection include a site for a new Mt. Zion area substation?

A. Yes. Staff has identified a primary and secondary location. Both the primary and secondary locations identified by Staff move the Mt. Zion substation approximately 3 miles to the south of the location proposed by ATXI.

Q. Does ATXI have a preference as to substation location?

A. In locating substations it is always best for their location to be immediately adjacent to or near the load they supply, as this will result in the strongest possible voltage support. Therefore ATXI's preferred location for the Mt. Zion substation is its originally proposed location, which is closer to the existing Decatur area transmission system and the Decatur load. Mr. Hackman also addresses this issue.

V. THE NEED FOR BAAH 345 KV ELECTRICAL BUS CONFIGURATIONS AT CERTAIN SUBSTATIONS

Q. Why is the electrical configuration and type of the substation equipment important?

A. From an electrical planning perspective, the configuration is important because it impacts the electrical functioning of the system. The configuration of the substation equipment is also a driver of the physical space required for the equipment at the substation. As Mr. Hackman explains in his rehearing direct testimony, the amount of physical space required for substation equipment in turn dictates the amount of real estate ATXI needs for its substations. In particular, ATXI's planned current or future use of BAAH electrical configurations requires more space than most other bus configurations. Below, I explain why using BAAH, or a physical equipment configuration easily expandable to BAAH, is the best way to plan the Project substations. Mr. Hackman addresses the type and physical arrangement of the actual equipment at the substation sites.

Q. How is the electrical configuration determined?

A. The initial configuration is determined based upon the number of planned initial connections to the 345 kV bus. A planner must also consider the potential for future connections to the bus. Where additional future bus connections can be expected, it is prudent and economically beneficial to use a physical equipment arrangement that can easily accommodate the future connections to the bus. The process for establishing the physical arrangement is described by Mr. Hackman.

Q. Can you explain why the electrical configurations for Pana, Kansas, Sidney, Rising and Ipava are what they are?

A. Yes. Pana, Kansas and Sidney substations will be BAAH configurations because of the number of bus connections and the superior reliability and operational benefits it provides. Ipava and Rising substations will initially be ring bus configurations because they will have fewer initial bus connections than the other substations. However, before a discussion of the Project substations, it is first necessary to understand what the common types of substation bus configurations are in order to understand why ATXI selected the configurations it did.

Q. What bus configurations did ATXI consider during the substation design process?

A. I will briefly describe the various types of bus configurations that are commonly used in the industry along with their strengths and drawbacks.

- Straight Bus (configuration one-line diagram is shown in ATXI Exhibit 1.7 (RH)). Each transmission line is connected to the bus by a single circuit breaker. This is a simple configuration and therefore relatively low-cost, but is also the least reliable of all configurations. As the diagram shows, the transmission line must be disconnected from the substation bus to safely perform maintenance activities on the circuit breaker connecting the line to the bus. Therefore, routine maintenance activities on a straight bus regularly remove a piece of the transmission network (the circuit breaker) from service and reduce the electrical grid's ability to reliably operate if a system failure or fault occurs. Additionally, even when all the circuit breakers are operational, if a circuit breaker fails or a fault occurs on the substation bus, the entire substation bus must be immediately de-energized in order to protect the rest of the electrical grid. The de-energization requires all connections to the substation bus to be severed and results in the loss of all transmission line connections. If the bus is not immediately de-energized, it could trigger a potential domino-effect of failures of other transmission lines and substations. Due to these concerns, Ameren's practice is to not allow straight bus configurations for new 345 kV buses.

- Single Ring Bus (configuration one-line diagram is shown in ATXI Exhibit 1.1 (RH)). In a ring bus configuration, there is a closed loop of electrical connections with each bus section separated by a circuit breaker. This allows a circuit breaker to be de-energized for maintenance activities while still keeping the associated transmission line electrically connected to the bus. Therefore this configuration provides greater reliability and allows for more flexible operation than a straight bus configuration. Ring bus configurations work well when no more than four connections are made to the bus. However, problems can occur with a ring bus configuration when more than four electrical connections are made to the bus and the bus is located in a competitive wholesale energy market. If either: (i) a circuit breaker is de-energized for maintenance and another transmission line connected to the bus experiences a fault, or (ii) multiple transmission line faults occur, then the ring bus may be split into two electrically separate sections. This can result in undesirable combinations of transmission lines being grouped on the bus sections. This can create transmission system congestion, which often requires reducing low cost generation and increasing the use of higher cost generation to supply customer load. Thus, congestion results in a higher cost of energy for customers.

- Double Ring Bus (configuration one-line diagram is shown in ATXI Exhibit 1.2 (RH)). A double ring configuration consists of two ring buses with at least one and sometimes two electrical connections between the rings. This configuration is an improvement over a very large single ring bus with many connections because it limits the impact of a bus fault to only one of the rings. However, a double ring bus can still be split into separate bus sections due to a combination of maintenance activities and/or system faults. As described previously, splitting a ring bus into separate sections will disrupt the normal bus connections and can cause increased system congestion, which negatively impacts the ability to move energy across the transmission system and results in higher costs for consumers. At this time ATXI does not have any double ring bus configurations with bus tie breakers and has no current plans to implement this type of bus configuration.

- <u>Breaker And A Half (BAAH) Bus</u> (configuration one-line diagram is shown in ATXI Exhibit 1.3 (RH)). In this design, for every two transmission lines there are three circuit breakers, with each transmission line sharing a common center circuit breaker. The combination of two transmission lines and their associated three circuit breakers are commonly referred to as a "breaker-string." At the end of each breaker-string is an electrical bus, which provides a connection between the breaker strings. This configuration provides improved reliability and enhanced operational flexibility compared to a straight or ring bus configuration. Any circuit breaker can be removed for maintenance without effecting the connection of any transmission line to an electrical bus. A fault on one of the two buses will not impact the other bus and therefore all connections to the transmission lines will be maintained. The ability to maintain transmission line connections even if various combinations of maintenance activities and/or system faults occur is a major benefit of a BAAH configuration and makes this configuration very reliable. Additionally, with a BAAH configuration the transmission system's performance does not degrade as the number of connections increases because additional breaker-strings can be added without impacting any of the other breaker strings or transmission lines. Therefore a BAAH design allows much easier expansion to connect future transmission lines, generation sources and other equipment compared to a straight bus, single ring bus or double ring bus configuration

- <u>Double-Bus, Double-Breaker</u> (configuration one-line diagram is shown in ATXI Exhibit 1.8 (RH)). In certain circumstances, a double-bus, double-breaker arrangement is used so that each transmission line has two separate circuit breakers, each connecting to a separate bus. This is the most reliable and the most expensive configuration of those I have described. At this time ATXI has not identified a location where this type of configuration would be needed.

There are hybrids of the previously described configurations, but the previous discussion covers the vast majority of substations in service today.

Q. How did ATXI select the electrical bus configurations that will be implemented at the Project substations?

A. ATXI will utilize BAAH where appropriate at some substations and ring bus configurations at other substations. Ameren's practice is to implement a BAAH configuration for new 345 kV buses that either have, or have high probability of eventually having, five or more connections. The practice is to limit new 345 kV ring bus configurations to locations where there is a very low possibility of more than four electrical connections being made to the bus. This practice also permits new ring bus configurations to be used as an interim step before future connections are made. In that case, for new 345 kV buses that initially have four or fewer connections but are expected to have five or more connections in the future, as Mr. Hackman explains in his testimony, ATXI develops and physically arranges the substation sites and equipment to support future BAAH installations. This is what is proposed for Ipava and Rising substations.

Q. Is the use of BAAH electrical configurations and the ability to reconfigure ring bus arrangements into BAAH electrical configurations in the future of particular relevance to the MVPs and Project?

A. Yes. As I stated previously, reducing or eliminating sources of system congestion is especially important for the MVPs and the Project because two of the major benefits are increased access to renewable energy and lower cost energy. These benefits will be reduced if ring bus configurations with five or more connections are used, because as previously described this configuration will result in increased system congestion and higher costs for energy delivered to the Ameren Illinois customers. Additionally, the MVPs are part of the high voltage network and additional connections can be expected as the electric grid continues to expand in response to increase demand for renewable energy and access to lower cost energy.

Q. Is there a cost difference between a BAAH configuration and a ring bus configuration?

A. Yes. Based upon past experience, we would estimate a new greenfield BAAH implementation costs approximately 17% more than a similar ring bus configuration. As an example, based upon our experience with constructing high voltage substations, the approximate cost of engineering design, materials, property and construction for a new 6-position, 345kV ring bus with a 345/138 kV transformer is approximately $20.8 million. Assuming the same location for the substation, the estimated cost of a new, 6-position, 345kV BAAH bus with a 345/138 kV transformer is approximately $24.3 million. The increased cost for a BAAH configuration is for three additional circuit breakers and the additional property that is required due to the need for space for the additional equipment.

In the case of the Project's Ipava and Rising substations, they are initially ring bus configurations, therefore the only the additional cost at these substations is for property to allow physical expansion at a later date. No additional substation equipment is being purchased for these two substations.

Q. Why is the additional cost justified in the case of the Project?

A. Because of the increased reliability and reducing congestion benefits that are provided by a BAAH configuration. These benefits are especially important because two of the major goals of the Project are providing customers with greatly increased access to renewable energy and lower cost energy in Illinois and throughout the MISO system footprint. The MVP routes (including the Project) were selected to accommodate areas of probable renewable energy resource development as well as the potential development of other generation resources (natural gas combustion turbines, coal gasification, clean coal, etc.). Additionally, as the transmission grid evolves to carry more and more energy over longer distances in order to lower the total cost of energy to the consumer, there will need to be additional connections at major transmission substations. BAAH will help support the delivery of renewable resources and these potential future connections. Lastly, any cost to prepare for future bus connections and implementation of a BAAH configuration is included as part of the MVP portfolio and will be cost shared.

Q. Is ATXI sizing and arranging all of the MVP substations for additional 345 kV connections?

A. Yes. The MVPs (including the Project) were located to facilitate the connection of renewable generation as well as other types of generation resources. Therefore ATXI expects and is planning for future substation connections to lines which will provide access to renewable resources as well as other forms of resources under consideration such as clean coal. Several Project substations also supply load pockets that may require additional transformers and/or transmission line connections to reliably serve the load in the future. Therefore, ATXI believes there is a very high likelihood of additional future connections at all of the Project substations and is taking prudent steps to ensure the substations are adequately sized for expansion and reconfiguration to support these connections.

Q. What happens if the Project substations are not sized to accommodate current or future BAAH?

A. If the Ipava and Rising substations were physically limited to ring bus electrical configurations then their ability to support future connections will be impaired, the potential for system congestion will increase, and system reliability will be less that if they could be reconfigured to have a BAAH electrical configuration. If the Project substations are not sufficiently sized or physically arranged to accommodate a future BAAH configuration, when additional projects are needed to maintain the reliability of the grid or serve new load, Ameren Illinois area customers would likely pay 100% of the cost for procurement of property and modifications to the existing equipment arrangement required to accommodate conversion of the bus to a BAAH configuration. Procuring the additional property now will eliminate the risk of the property not being available in the future, or available but only at a much higher cost. ATXI is therefore procuring sufficient property and physically arranging the initial 345 kV substation equipment so that in the future it can be converted to a BAAH configuration

Q. Describe the planned Pana, Kansas, and Sidney MVP substation connections that drive their need to have a BAAH 345 kV electrical bus configuration?

A. When the Project is fully implemented, these substations will each have five or more connections to their 345 kV bus and will therefore have BAAH electrical configurations due to the many advantages it provides including reduced congestion, easily expandable to connect new lines or generation resources, etc. ATXI will therefore implement BAAH 345 kV bus configurations at these substations.

- The Pana substation will initially have six connections to its 345 kV bus (a line to Kincaid, a line to Pawnee, a line to Mt. Zion, a line to Coffeen, and two 345/138 kV transformers).
- The Kansas substation will initially have six connections to its 345 kV bus (a line to Sidney, a line to Mt. Zion, a line to Sugar Creek, a line to Casey, and two 345/138 kV transformers).
- The Sidney substation will initially have five connections to its 345 kV bus (a line to Bunsonville, a line to Rising, a line to Kansas, and two 345/138 kV transformers).

Q. Why has ATXI planned the Ipava and Rising substations to initially have ring bus configurations?

A. These two substations will initially have less than four connections to the 345 kV bus when the Project is completed. Therefore it is acceptable to implement a ring bus configuration in order to help manage project costs. The Ipava substation will initially have three connections to its 345 kV bus (a line to Duck Creek, a line to Meredosia, and a 345/138 kV transformer) and will therefore initially be a ring bus configuration. The Rising substation will initially have three connections to its 345 kV bus (a line to Goose Creek, a line to Sidney, and a 345/138 kV transformer) and will therefore initially be a ring bus configuration. However, ATXI also determined that a number of future additional connections could be expected to be made at Ipava and Rising due to their location near the MISO-PJM seam or locations with potential new generation resource development. The total number of current and future connections dictates the ultimate configuration of the substation. Since the total number of potential connections is more than four, ATXI is designing the ring bus configuration at Ipava and Rising to be easily expandable to BAAH. Mr. Hackman discussed the physical bus arrangements in more detail.

Q. Is it prudent to size both the Sidney and Rising substations for future expansion when they are in relatively close proximity to each other?

A. Yes. ATXI understands that the Sidney substation with its BAAH configuration would be a desirable location for future transmission connections due to the previously described benefits of a BAAH configuration. ATXI then considered the potential for new connections to occur at the Rising substation and the advisability of planning the Rising substation for eventual reconfiguration into a BAAH arrangement. ATXI considered several important factors when deciding whether or not to physically size the Rising substation and arrange the equipment for future conversion to a BAAH configuration. The factors considered included: the close proximity of the Rising substation to the PJM "seam" and the high potential for additional inter RTO connections, the potential future development of a 345 kV electrical loop around the Champaign area, and the potential for additional generation development in the area near the substation, ATXI concluded that it was prudent to proceed with physically sizing the Rising substation and arranging the equipment for future conversion to a BAAH configuration.

VI. <u>CONCLUSION</u>

Q. Does this conclude your direct testimony on rehearing?

A. Yes, it does.